

Wastewater Optimization Program

Communities frequently begin energy-efficiency projects with lighting or mechanical system upgrades in public buildings, or by looking at the fuel efficiency of their vehicles. However, one of the largest energy-consuming operations in most cities is often a missed opportunity: drinking water and wastewater treatment systems. Nationally, three to four percent of all electricity produced is used for treating wastewater and distributing drinking water.

Typically, these systems account for 35 percent of a city's municipal energy budget. Of that, 60 percent of a wastewater treatment plant's energy consumption is for aeration. For decades, wastewater operators were taught to aerate 24/7/365 to ensure compliance. Energy conservation was not a priority, since most staff never saw their energy bills.

To address energy conservation and other operational practices, the Tennessee Department of Environment and Conservation (TDEC) Division of Water Resources and Office of Policy and Sustainable Practices created the Tennessee Water and Wastewater Energy Efficiency Partnership in 2011 with EPA Region 4, the University of Tennessee Municipal Technical Advisory Service (MTAS), the Tennessee Valley Authority (TVA), and the University of Memphis. The goal of the Partnership was to provide a more focused process and resources to help utilities understand the impact of energy use and to identify opportunities for energy conservation through optimization.

From 2011 to 2015, the Partnership provided no-cost technical assistance to water and wastewater systems to identify operational strategies, which, once implemented, resulted in reduction in energy usage, energy cost savings, and often a reduction in nutrient discharge. Fewer nutrients lead to cleaner streams and rivers. In 2016, the U.S. Department of Energy provided a State Energy Program Competitive Award to the TDEC Office of Energy Programs to continue the efforts of the Partnership while helping the State of Alabama



implement a similar program.

Since 2011, the Partnership has assessed 41 water and wastewater systems across Tennessee and conducted 14 workshops to train operators how to better run their facilities. The Partnership has also worked directly with operators to implement no-to-low-cost recommendations, such as on/off aeration cycles, which can greatly reduce a facility's total energy use.

The assessments relied on the Bio-Tiger model developed by Dr. Larry Moore, Professor of Civil Engineering at the University of Memphis. His model was packaged into a user-friendly spreadsheet that allows operators to compare different operational scenarios and may be found on TDEC's website along with a training video and user manual.

The Partnership is an excellent example of governmental entities, utilities and public higher education institutions working together to better our communities and environment. Water and wastewater systems participating in the Partnership identified potential

measures which would result in significant annual energy savings of over 17,000,000 kilowatt-hours (kWh) and cost savings of \$2 million. Approximately 40 percent of those identified measures have been implemented. The Partnership continues to work with systems to increase implementation of optimization measures. On average, implementation of the Partnership's recommendations reduces a system's annual energy costs by nearly 20 percent and, in some cases, reduced total nutrient discharge by 40 percent.

The Carthage Wastewater Treatment Plant was one of many wastewater treatment plants (WWTPs) invited to participate in the partnership. This WWTP has a design capacity of 625,000 gallons per day (gpd), and currently treats about 330,000 gpd of municipal wastewater. The plant has an annular aeration basin with a final clarifier in the center. Bio-solids generated during treatment are further treated in two aerobic digesters, operated in series.

The team recommended reducing the operating time of the aerator in the

second digester from constant operation to only six hours per day. Beginning in April 2017, the plant staff started manually adjusting the aerator operation schedule as a part of routine duties. This single change reduced electricity use by 14 percent, and saved over 7,000 kWh per month despite a 15-percent increase in wastewater loading. Staff expects to use some of the savings to purchase and install timers in the near future. The timers will automate this change and manage further reductions.

Through these operational changes, the Carthage WWTP has seen cost savings in their electric bill as well. "We have averaged saving \$401 a month (on a \$4,181 monthly bill)," says Ricky Brown with Carthage WWTP. "This was accomplished by reducing the amount of time we run our blowers on the final digester. We are in the process of reducing the time even more. We will continue to monitor odor control and permit levels until we achieve

the maximum savings we can during operation."

Another WWTP invited to participate was the Lawrenceburg WWTP, which was running two 40-HP blowers for 16 hours a day. Instead, the team recommended only running one 40-HP blower for six to eight hours a day. In August 2018, Lawrenceburg replaced their fine bubble diffusers in the sequencing batch reactors, which needed changing. These no-to-low-cost measures account for an average decrease in electricity consumption of 29,000 kWh monthly (or ~348,000 kWh annually) and an estimated \$1,700 reduction in monthly electricity bills (about \$20,000 annually), all while absorbing a 14-percent increase in flow and biochemical oxygen demand removal. Ben Bolton, TDEC Energy Programs Administrator, has managed the DOE-funded project since starting with TDEC in 2015 and commented, "These wastewater operators dedicate their

daily lives to making sure we have clean water, but the operators and managers in this program dedicate themselves to finding new ways to save their communities money, while improving their environmental outcomes."

The success of TDEC's Wastewater Optimization Program has inspired similar programs in Alabama and Kentucky, while other states are exploring doing the same. One of the key lessons learned is the need for continuing engagement by TDEC with the participating wastewater systems. To foster success, TDEC and the Partnership encourage implementation and how to maintain optimization measures, provide technical assistance in process optimization and data tracking, all the while encouraging support from the town leaders and management for the treatment plant staff. TDEC is exploring how to integrate these efforts into wastewater operator and field inspector training through the development of electronic training resources. Meanwhile, water and wastewater systems may still receive assistance through Brett Ward at MTAS or through Dr. Glenn Cunningham, Director of the DOE-funded Industrial Assessment Center at Tennessee Technological University. www.tn.gov

NOTICE: This material is based upon work supported by the U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy (EERE), under Award Number DE-EE0007226.



ABOVE: The day after the project team's site visit, Carthage Wastewater Treatment Plant operators Steve Key (left) and Ricky Brown (right) began implementing the recommendations. Their dedication led to a 19-percent cost savings (\$/MG treated) with no capital investment. **TOP LEFT:** During a typical site visit, Bob Freeman, P.E., Softpath Environmental and retired from EPA Region 4 (left), will take real time water quality measurements while Larry Moore, P.E. Ph.D., Professor Emeritus, Civil Engineering, University of Memphis (right) will discuss operations with plant staff (center). **BOTTOM LEFT:** Dr. Larry Moore, University of Memphis, (center) and Brett Ward, MTAS (right), discuss optimization opportunities with wastewater staff in Columbia, TN.